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Ultra-thin nickel-based castings improve engines

by Fred Coleman, Materials and Manufacturing directorate

WRIGHT-PATTERSON AFB, OHIO — Scientists here have developed an advanced manufacturing process for coating engine components with ultra-thin layers of nickel.

These ultra-thin nickel castings will help reduce engine cost and weight, improve thrust-to-weight ratio, increase durability and improve range. With this technology, defense manufacturers can apply the castings to retrofitable engine components. It also has application to the castings on commercial engines. The new castings could save $40,000 per engine.

"Of course, we're always trying to reduce costs of aircraft components," said Rafael Reed, project manager for the program. "But this new technology will also help meet our needs for lighter aircraft."

FLYING HIGH WITH AN IMPROVED ENGINE — Ultra-thin cast components will improve engines, such as the F-22's F119 turbine engine, by improving thrust-to-weight ratio, increasing durability and improving range. The new castings are being developed by the Materials and Manufacturing directorate at Wright-Patterson AFB, Ohio.

Researchers from the lab's Materials and Manufacturing directorate here and at United Technologies Corporation are developing cost-effective manufacturing processes that will produce ultra-thin, 20-30 mil thick cast components. These new coating processes would be used to modify existing Air Force and Navy weapon systems that require lightweight components.

Current, state-of-the-art casting techniques are limited to 0.060 - 0.070 inch minimum thickness, so many cast aircraft turbine engine components are manufactured thicker than necessary.

According to the project researchers, they have cast small-scale, ultra-thin structures in the range of 0.020 - 0.030 inches thick; however, they're still working on how to exploit this technology to cost effectively make reproducible and reliable large, geometrically complex components.

They are currently working on the F119 turbine exhaust case, a multi-piece fabricated component consisting of 480 separate parts and nine manufacturing operations. With the improved processes under study, a cast, one-piece design would reduce the case to 112 separate parts, with only three manufacturing operations.

"This casting process is being used to cast subcomponents for the Component and Engine Structural Assessment Research engine," Reed said. "After these tests on the engine, the subcomponents will be evaluated and a cost analysis completed for a full-scale component."

Continued improvements in gas turbine technology could lead to the development of lower-weight structural components, with higher metal temperature capability. **@**